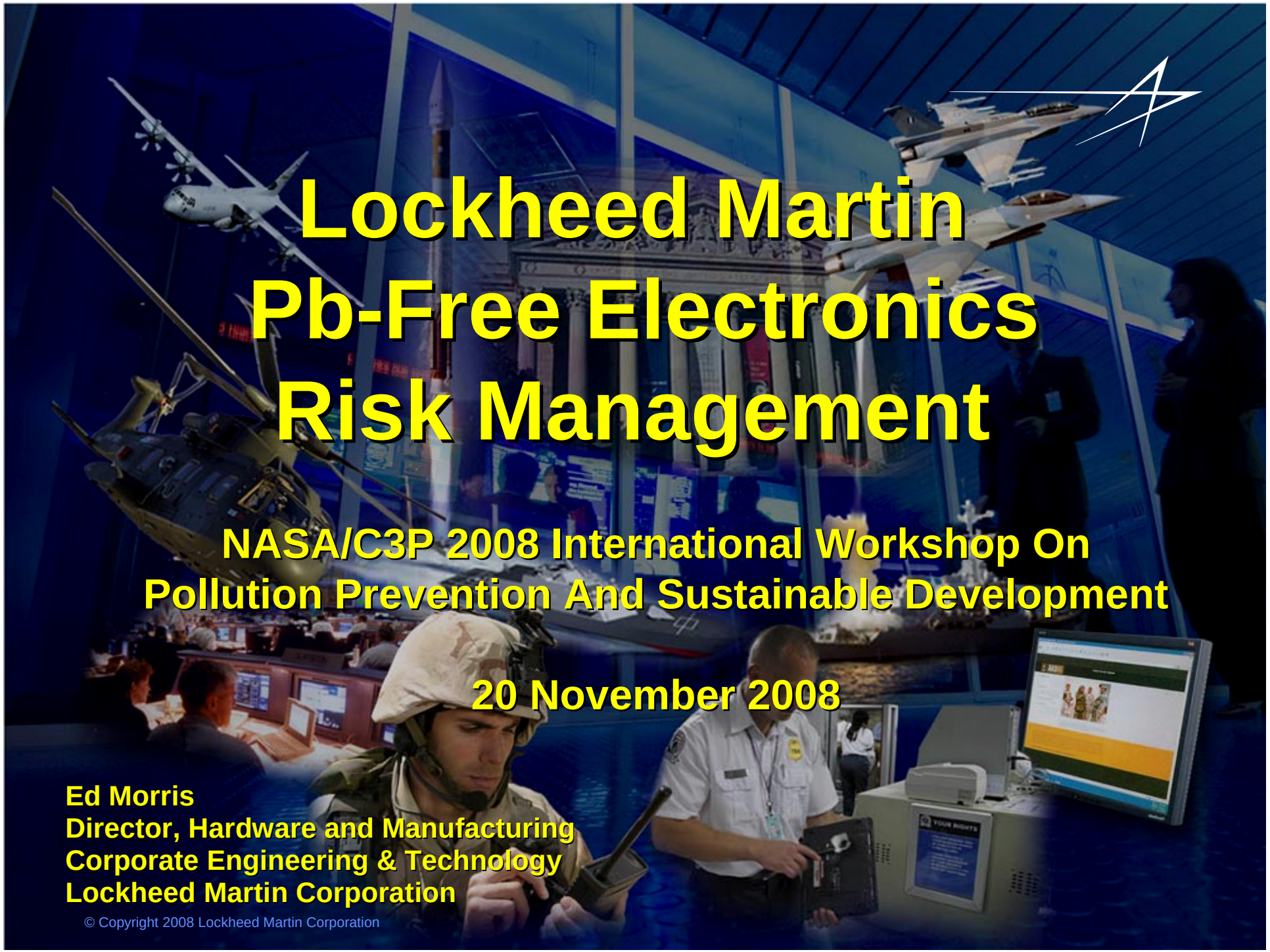

Lockheed Martin Pb-Free Electronics Risk Management

NASA/C3P 2008 International Workshop On Pollution Prevention And Sustainable Development

20 November 2008

Ed Morris
Director, Hardware and Manufacturing
Corporate Engineering & Technology
Lockheed Martin Corporation

Discussion Topics

- *Lockheed Martin Overview*
- *Pb-free Electronics Risk Management Priorities*
- *Stakeholder Organizations*
- *Pb-free Electronics Policy*
- *LMC Pb-free Working Group Activities*
- *Participation in Government & Industry Activities*
- *Pb-Free Electronics Research "Manhattan Project" Concept*
- *Summary Observations*

The Men and Women of Lockheed Martin

- *140,000 Employees*
- *70,000 Scientists and Engineers*
  - *25,000 IT Professionals*
- *Operations in 1,000 Facilities, 500 Cities, 50 States and 75 Countries*

Partners to Help Customers Meet Their Defining Moments

Our Customers

- Departments of
  - Defense
  - Homeland Security
  - Commerce
  - Energy
  - Health & Human Services
  - Housing & Urban Development
  - Justice
  - State
  - Transportation
- NASA
- Social Security Administration
- Environmental Protection Agency
- U.S. Postal Service
- Intelligence Communities
- Foreign Governments

We Never Forget Who We're Working For ™

Lockheed Martin Business Areas

Aeronautics

Electronic Systems

Missiles and Fire Control

Maritime Systems and Sensors

Platform Integration

Training and Simulation

Energy Programs

Space Systems

Information Systems & Global Services

Mission Solutions

Information Systems

Global Services

LMC Pb-Free Electronics Risk Management Priorities

- ***Increase Awareness of Pb-free Electronics Risks across LMC***
- ***Promote Risk Mitigation Actions to Protect LMC Mission Success***
- ***Provide Risk Mitigation Resources to the Business Units***
- ***Aggressively Track & Influence Government & Industry Activities to Mitigate / Eliminate Risks***

LMC Pb-Free Electronics Functional Stakeholder Organizations

- **Corporate Engineering & Technology – Pb-free Electronics Lead**
  - ***Director – Hardware and Manufacturing (Pb-Free Electronics Lead)***
  - ***Director – Mission Assurance***
  - ***Engineering Process Improvement Center***
    - ***PWB/CCA Subcouncil / Pb-free Working Group***
    - ***Electrical Engineering Subcouncil***
    - ***Specialty Engineering Subcouncil***

- **Corporate Shared Services**
  - ***Energy Environment Safety and Health***
  - ***Global Supply Chain Management***

- **Other Pb-Free Electronics Management Core Team Participants**
  - ***Program Management***
  - ***Contracts / Finance / Legal***
  - ***Subcontract Management***
  - ***Manufacturing***
  - ***Configuration Control***
  - ***Logistics***
  - ***Business Development***

LMC Pb-free Electronics Policy

- ***Policy Letter issued by Dr. Ray Johnson, LM Chief Technical Officer, on 25 August 2008 signature***

- ***Per the Policy Letter, Lockheed Martin will:***
  - *Continue to use SnPb electronics to meet product performance and service life requirements*
    - *Pb-free electronics may be utilized provided that appropriate engineering analysis or testing determines that all mission requirements are met*
  - *Actively manage the unplanned intrusions of Pb-free electronics into our products*
  - *Develop and deploy a corporate Lead Free Control Plan (LFCP) as a risk management tool and establish LFCPs for each applicable business unit, site, and/or program*
  - *Prepare for an inevitable shift to Pb-free electronics in an orderly manner*

LMC Pb-Free Working Group (WG)

- ***Facilitated by Corporate Engineering &Technology Engineering Process Improvement Center (EPI)***
- ***Managed within the PWB/CCA Subcouncil***
  - *Pb-free electronics is an increasing proportion of Subcouncil's activities*
  - *Developed plan for corporate Pb-free effort in 2006*
- ***Cross-functional membership from across LMC businesses in order to leverage and share local Pb-free electronics activities***
- ***Activities planned on an annual basis***
  - *Based on business needs as determined by members*
  - *Plans approved by technical oversight board*

LMC Pb-Free WG Products

- ***Released documents***

No.	Title
100-22	Lockheed Martin Corporation Pb-free Materials Position Statement
100-22C	Pb-free Strategic Roadmap
100-22D	Mechanism for Effectively Leveraging Industry Association Information
100-35A	Mitigating Methods for Tin Whisker Growth when using Tin-Plated Terminations
100-35B	Manufacturing Guidelines for Mitigating Tin Whisker Growth from Pure Tin-Plated Terminations
100-35C	Guidelines for Using Supplier and Industry Data to Mitigate the Risk of Tin Whisker Failures
100-35D	Lead-Free PO Note Guidance for Purchase of Electronic and Electrical Components
100-60	Lockheed Martin Corporation Lead-Free Control Plan

- ***Deliverables in development***
  - *Pb-free Electronics "Phase 2" Strategy Paper*
  - *Tin Whisker Tactical Guidance Document*
  - *Formalized Corporate-level Awareness Training*

LM Generic Lead-Free Control Plan (LFCP) Objectives & Content

- ***Objectives***
  - ***Identify and control the risks to product performance created by the industry transition to Pb-Free Electronics***
  - ***Proactive response to anticipated customer requirements for an LFCP***
  - ***Consistent, standardized approach to addressing the risks and meeting customer needs***
    - ***Promotes a "One Company" image to our customers***
    - ***Assessment by internal and external auditors more efficient***
    - ***Can be tailored to meet unique customer and program requirements***

- ***EPI 100-60 Lead-Free Control Plan Content***
  - ***Reliability***
  - ***Configuration Control and Product Identification***
  - ***Risks and Limitations of Use***
  - ***Deleterious Effects of Tin Whiskers***
  - ***Repair, Rework, Maintenance and Support***
  - ***Plan Administration***
  - ***Tailoring***

LFCP Preparation Background & Status

- ***EPI 100-60 content meets the requirements of industry standards***
  - ***GEIA-STD-0005-1: Performance Standard for Aerospace and High Performance Electronic Systems Containing Lead-free Solder***
  - ***GEIA-STD-0005-2: Standard for Mitigating the Effects of Tin Whiskers in Aerospace and High Performance Electronic Systems***

- ***Prepared by cross-business, multi-functional LFCP team established in January 2008***
  - ***Used a Systems Engineering approach with Requirements Matrix allocated to LFCP Sections***
  - ***Final Document released on September 26, 2008***

- ***Future LFCP Working Group Actions***
  - ***Establish Assessment Criteria & Site Compliance Map/Methodology***
  - ***Develop Tailoring Guidelines***

Corporate LFCP Challenges

- ***Accommodating multiple customers and internal stakeholders***
- ***Accommodating the full range of Control Levels***
  - **Level 1.** ***No restrictions on Pb-free tin finish use***
  - **Level 2.** ***Pb-free tin finish is allowed under some circumstances***
    - **Level 2A.** ***Use of Pb-free tin finish without explicit controls is acceptable under most circumstances***
    - **Level 2B.** ***Pb-free tin finishes may be used but only with customer approved and specified control measures***
    - **Level 2C.** ***Restricted use of Pb-free tin finish***

  Dominant Position

  - **Level 3.** ***Use of Pb-free tin finish is prohibited and measures must be taken to verify compliance***
- ***Determining the extent of implementation in advance of customer direction & funding***

Additional LMC Pb-free Electronics Management Activities

- ***Pb-Free Electronics Awareness training across the LM stakeholders***
  - *Continuing to give Pb-free Electronics Awareness Briefings across the Corporation*
  - *Publishing Pb-free Electronics articles in EPIC Newsletter*
  - *Using Pb-Free WG Email Forum to Communicate Pb-Free Electronics Information, and Other Communities' Forums as Appropriate*
  - *Pb-free Working Group meetings include LMC customers, suppliers, and BA/BU participants*
  - *On-Line Pb-Free Electronics Awareness Course is in work*

Additional LMC Pb-free Electronics Management Activities (Cont'd)

- ***Selectively investing R&D on the topic, being careful to not duplicate efforts outside and within LMC***
  - *Funding University of Puerto Rico at Mayaguez to do literature searches and assess solder & finish compatibilities for Lockheed Martin*
  - *CALCE & UNOVIS memberships continue to be a wise investments to leverage our research funds*
  - *Actively participating in the NASA – DoD Pb-Free Project that is studying Pb-Free electronics manufacturing, repairs and reliability*

LMC Participation in Government & Industry Activities

- *AIA Technical Operations Council, Engineering Management Committee, and Ad Hoc Pb-Free Electronics Strategy Team*
- *AIA-AMC-GEIA LEAP (Lead-free Electronics in Aerospace Project) WG*
- *ELF IPT (Executive Lead-Free Integrated Process Team)*
- *IPC (Association Connecting Electronic Industries)*
- *CALCE (Center for Advanced Life Cycle Engineering, Univ. of Maryland) Electronic Products and Systems Consortium*
- *Unovis A.R.E.A. Consortium (formerly Universal Instruments)*
- *NASA – DoD Lead-Free Electronics (LFE) Project*
- *NSWC – Crane Lead Free Repair Project*
- *DoD ManTech Pb-free Electronics Initiatives*

Staying Up-to-date on Pb-Free Electronics Activities Is a 24/7 Activity!

Pb-Free Electronics Research "Manhattan Project" Concept

- ***Who:***
  - *Nationally recognized 10-15 deep subject matter experts assembled to work as a single, fully-funded team*
  - *Strong team leader with requisite management & technical skills*
  - *Government Funding Champion at highest possible level*
- ***What:*** *"Find acceptable replacements for Pb in electronics for use in aerospace and defense environments" (Dual Use)*
- ***When:*** *Begin ASAP with a 3-year commitment and hope for shorter*
- ***Where:*** *National Lab or Center such as the EMPF as the "Research Center" with access to other facilities as needed*
- ***How:*** *$60M Dedicated "Pocket change funding" compared to the scope of the problem ($20M/year = 15 SMEs + $14M Research $)*
- ***Why:*** *Given time, the "Business Case" will become self-evident based on events, even to the most strident "nay sayers"*

A Radical Approach to a Complex Dilemma

Critical "ASAP" Next Step

- ***Pb-free Electronics Research "Mini" Manhattan Project Team Benchmarking & Roadmapping Study***
  - *Phase 1: Identify current best practices to deal with Pb-free electronics (2 Weeks)*
  - *Phase 2: Define the scope of research to address the gaps & Establish the CONOPS for project execution (2 Weeks)*
- ***B2P COE to provide meeting coordination, oversight, and participant funding***
- ***Industry participants will be by invitation only***
- ***Anticipate Go-Ahead in 1st Quarter 2009***

Take-Aways: Pb-free Electronics Manhattan Project Concept Validation and Technical Path Forward

Summary Observations

- ***The cultural issues regarding the Pb-free Electronics debacle are as complex as the technical issues***
  - ***"I have more important, immediate problems."***
  - ***"I cannot obtain funding for a research project for which there is no clear solution, no definitive schedule, and no grasp of the total funds required."***
  - ***"Show me the recent evidence that this is a problem that merits my attention." versus "We cannot share this with anyone."***
  - ***"This is everyone's problem, therefore it's no one's problem."***
- ***We cannot afford to fail!***

Pb-Free Is Not Free!!